

REMARKS

This paper accompanies a request for continued examination ("RCE") and is presented in response to the final official action dated January 25, 2008, wherein: (a) claims 1, 2, 4-7, 9-15, and 17-22 were pending; and, (b) claims 1, 2, 4-7, 9-15, and 17-22 were rejected under 35 USC § 103(a) as obvious over Medoff et al. U.S. Patent No. 6,207,729 ("Medoff") in view of Sato U.S. Patent No. 4,619,962 ("Sato") and Polovina U.S. Patent No. 3,637,571 ("Polovina").

The amendments submitted in the after-final amendment dated March 11, 2008 were not entered. See Advisory action dated April 18, 2008. Accordingly, the present claim amendments have markings indicating additions and deletions relative to the most recently entered amendments from the response dated November 2, 2007. Further, the present remarks address the additional reasoning supporting the obviousness rejection provided at p. 2-5 of the advisory action.

Reconsideration and withdrawal of the rejection are respectfully requested in view of the following remarks.

Attached hereto are three excerpts from the *Kirk-Othmer Encyclopedia of Chemical Technology* (3rd ed. (1980)). The excerpts are relevant to technical issues addressed in more detail below, including the function of a heat stabilizer polymeric additive (vol. 12), the physical properties of high-density polyethylene (vol. 16), and the physical properties of polyamides (vol. 18).

I. Brief Summary of the Amendments to the Claims

Claims 1, 10, 18, and 22 have been amended for clarity. No change in claim scope is intended or effected by these amendments.

Claim 6 has been canceled.

II. The 35 USC § 103(a) Rejections Are Traversed

Claims 1, 2, 4-7, 9-15, and 17-22 were rejected as obvious over Medoff in view of Sato and Polovina. See p. 6-10 of the action. The applicants traverse the obviousness rejection as set forth below.

A. Proper Basis for an Obviousness Rejection

The PTO bears the initial burden of presenting a *prima facie* case of obviousness. *In re Oetiker*, 977 F.2d 1443, 1445 (Fed. Cir. 1992); see also MPEP § 2142 (8th ed., rev. 6, September 2007). A *prima facie* case of obviousness

requires that each and every limitation of the claim is described or suggested by the prior art, or would have been obvious based on the knowledge of those of ordinary skill in the art. *In re Fine*, 837 F.2d 1071, 1074 (Fed. Cir. 1988). Further, “rejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006). Thus, any analysis supporting an obviousness rejection should be made explicit and should “identify a reason that would have prompted a person of ordinary skill in the art to combine the elements” in the manner claimed. *KSR Int’l Co. v. Teleflex, Inc.*, 127 S.Ct. 1727, 1739 (2007).

When evaluating the teachings of the applied references, each reference must be considered in its entirety (i.e., as a whole), including portions that would lead away from a claimed process. *W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540 (Fed. Cir. 1983); MPEP § 2141.02(VI). If a proposed combination would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious. *In re Ratti*, 270 F.2d 810 (CCPA 1959); MPEP § 2143.01(VI).

Even though a conclusion of obviousness “is in a sense necessarily a reconstruction based on hindsight reasoning,” MPEP § 2145(X)(A) (citing *In re McLaughlin*, 443 F.2d 1392, 1395 (CCPA 1971)), there are limits to its application. Specifically, hindsight reconstruction of a claimed invention *using the applicant’s disclosure as a template* is impermissible and represents an insufficient basis to support a *prima facie* case of obviousness. The likelihood of impermissible hindsight increases along with the number and/or complexity of the claimed features asserted to be obvious. See *Ortho-McNeil Pharmaceutical, Inc. v. Mylan Laboratories, Inc.*, Appeal No. 2007-1223, slip op. at 10 (Fed. Cir. March 31, 2008) (explaining that “simply retrac[ing] the path of the inventor with hindsight, discount[ing] the number and complexity of alternatives ... is *always inappropriate* for an obviousness test” (emphasis added)).

B. Disclosure of the Applied References

Medoff is generally directed to texturized cellulosic (and lignocellulosic) materials and compositions using the same. Cut cellulosic material (e.g., flax, hemp)

is sheared with a rotary cutter to form a texturized fibrous material generally having a length/diameter ratio of at least about 5. Medoff, 1:26-40, 3:20-37. The texturized fibrous material can be combined with a resin to form a strong, lightweight composite. *Id.*, 4:26-27. Polyamide is generically disclosed in a list of suitable resins, although all of the example composites are formed using high-density polyethylene (HDPE). See *id.*, 4:48-56 (listing different resins), 7:8-9:14 (Compositions 1-7 of Example 2). Various conventional additives can be added to the composite, for example a heat stabilizer and/or an inorganic additive. *Id.*, 5:5-10. The composite can be formed and pelletized, for example using an extruder at less than about 190 °C to both melt the resin and mix the blend of resin and texturized fibrous material. *Id.*, 5:50-58. The composite can be used as a wood substitute and can be formed into a variety of rigid and/or inelastic articles. See *id.*, 6:14-46 (listing potential articles formed by the composite), 8:17-9:15 (Compositions 4-7 of Example 2 having an ultimate elongation of less than 5%).

Sato is generally directed to thermoplastic polymer compositions. Sato is particularly directed to a polymer blend of crystalline polyamide and a carboxylated synthetic rubber useful in the fabrication of low-permeability hoses. Sato, abstract. The polyamides generally include nylons with melting points ranging from 160 °C to 230 °C (e.g., nylon-6 at about 223 °C, nylon-11 at about 190 °C, and nylon-12 at about 179 °C).¹ *Id.*, 2:8-21. The synthetic rubber is formed from butadiene, (meth)acrylonitrile, and α,β -unsaturated carboxylic acid (e.g., acrylic) monomers. *Id.*, 2:22-33.

Sato's composition also includes two inorganic additives. A first additive is a metal halide (e.g., lithium chloride). *Id.*, 2:39-41. The halide can influence the melting point of the polyamide and/or promote the compatibility of the polyamide and the synthetic rubber. *Id.*, 2:43-47. A second additive is an oxide, a hydroxide, or a peroxide of a divalent metal. *Id.*, 2:60-63. The metal forms ionic crosslinks with the carboxylic acid groups in the synthetic rubber. *Id.*, 2:65-68.

Sato's composition is formed by mixing (e.g., in an extruder) the various components at a temperature sufficient to melt the polyamide, for example between about 180 °C and about 230 °C. *Id.*, 3:55-61, 4:1. The composition can then be

¹ See *Kirk-Othmer Encyclopedia of Chemical Technology*, 3rd ed. (1980), vol. 18, p. 360 (listing melting temperatures of various commercial polyamides).

molded into a shaped article at a temperature between about 180 °C and about 220 °C. *Id.*, 4:14-17. Sato's examples are all prepared using a mixer at 220 °C to melt nylon-11 as the polyamide and using a press at 200 °C to mold the mixed composition into sheets. *Id.*, 4:42-60. All four components (i.e., two polymers and two additives) are required to achieve the balance of desirable mechanical and physical properties that make the resulting composition useful as a flexible hose material. See *id.*, 3:1-3 (describing the contributions from the polyamide and the synthetic rubber), 4:18-35 (describing desirable properties and the imbalance resulting from the omission of the additives), 4:42-8:15 (examples illustrating the balance of properties, for example Experiments 24-27 having a tensile strength somewhat less than the pure polyamide (Experiment 28) but having a % elongation much higher than the pure polyamide)

Polovina is generally directed to a process for preparing thermoplastic resin-additive compositions. Polovina is cited for its teaching of a masterbatch process in which additives are added to a polymer that is then pelletized in an intermediate step prior to molding. Office action, p. 3 and 9.

C. Presentation of a *Prima Facie* Case of Obviousness

The action asserts that it would have been obvious to "incorporate the methods of Polovina and Sato into that of Medoff." Office action, p. 3. The action essentially combines the references by forming the polyamide-containing polymeric material of Sato to be used as a resin matrix in the composite composition of Medoff. See *id.*, p. 3-4 ("Medoff suggests a raw material ... which Sato provides by incorporating a metal salt additive." (citations omitted)). Polovina is cited merely for the teaching of a masterbatch process used to form the intermediate polyamide-containing polymeric material of Sato (i.e., which already contains a metal halide) into pellets prior to being used in Medoff's composite. *Id.*, p. 9.

Accordingly, the action effectively asserts that it would have been obvious to serially combine the processing steps of Sato, Polovina, and Medoff to predictably yield the claimed process. However, this rationale for a *prima facie* case of obviousness still relies on "a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does." MPEP § 2143(A) (citing *KSR*). Absent such a reason, "this

rationale cannot be used to support a conclusion that the claim would have been obvious to one of ordinary skill in the art.” MPEP § 2143(A).

As set forth in detail below, the applicants respectfully submit that the applied references fail to support a *prima facie* case of obviousness. Specifically, the proposed combination of Sato, Polovina, and Medoff impermissibly changes the principle of operation of the underlying references. Additionally, the action fails to provide adequate reasoning supporting its proposed combination of references.

1. Principle of Operation of the Applied References

Sato and Medoff are not properly combinable because each reference relates a composition whose mechanical properties are incompatible with the functional goals of the other reference. Accordingly, each reference teaches away from its combination with the other.

Medoff's composites are generally strong, rigid materials for use as a structural component of various articles. See Medoff, 6:14-46 (indicating the composite's suitability as a “wood substitute” and listing numerous rigid articles that can be formed therefrom). Even though some of the disclosed uses for the composite include flexible structures, the formed articles are nonetheless inelastic. See *id.* (listing, e.g., carpets and rugs as possible composite articles). Further, all of the example composites tested were inelastic, having an ultimate elongation of less than 5%. See *id.*, 8:17-9:15 (Compositions 4-7 of Example 2).

In contrast, Sato's polymer compositions are flexible and more elastic. The polymer is intended for use as a flexible hose material. Sato, 4:27-29. Further, the examples representing preferred formulations have ultimate elongation values of about 300%. See *id.*, 4:42-8:15 (summarizing example data in Tables I-VI).

The rejection is based on a proposed combination in which the composition from Sato is used a starting resin material for the composite of Medoff. See Section II.C above. However, it would be inappropriate to use the flexible, elastic material of Sato as a resin material to form the matrix of Medoff's strong, rigid composite (i.e., as proposed by the action). Specifically, Sato adds a carboxylated synthetic rubber to its polyamide-based polymer composition to improve the elastic properties of the resulting polymer *at the expense of* the polymer's strength. See Sato, 6:32-55 (comparing Experiments 21 and 28 in which the addition of 40 wt.% of a carboxylated synthetic rubber reduces the tensile strength from 36.5 MPa to

11.8 MPa). Conversely, Medoff adds its texturized fibrous material to a rigid, inelastic polymer matrix to *increase* the resulting composite's strength. Accordingly, serially combining Sato and Medoff impermissibly changes the principle of operation of Medoff (i.e., the primary reference being modified) by changing the basic mechanical characteristics of the composite formed in Medoff. *In re Ratti*, 270 F.2d 810.

In view of the foregoing, the applicants request reconsideration and withdrawal of the obviousness rejection.

2. Reason Prompting the Proposed Combination

Each of independent claims 1, 10, and 18 recites a thermoplastic polymer having a melting temperature of 200 °C or above and a first mixture whose melting temperature has been lowered to less than 200 °C by adding at least one of a particular metal halide salt to the thermoplastic polymer.

The action asserts that the skilled artisan would have selected a polyamide from Sato having a melting temperature of 200 °C or above and then added a sufficient amount of a metal halide salt to reduce the melting temperature below 200 °C because "suppression of melt temperature would be recognized as a desirable benefit of the additives regardless of their use with or without cellulose of other materials." Office action, p. 9. Further, the action reasons that "in view of Medoff's specific suggestion to provide heat stabilizers (5:7), it is submitted that heat degradation is a recognized problem, and that Sato provides an additive that would act as a heat stabilizer." *Id.* The advisory action further supports the obviousness rejection on the basis that (1) Medoff generically discloses "inorganic additives" and (2) "lithium chloride is an inorganic additive." Advisory action, p. 5.

The applicants respectfully disagree with this reasoning.

Neither the applied references nor the knowledge of the skilled artisan suggests the desirability of the recited limitations related to melting temperatures both above and below 200 °C. Medoff does not suggest the desirability of using a polyamide with a melting temperature of 200 °C or above, in particular because some common polyamides have melting temperatures below 200 °C in their neat form. See Sato, 2:8-21 (disclosing the melting point of common commercial nylons as ranging from 160 °C to 230 °C; *Kirk-Othmer*, vol. 18, p. 360 (listing the melting temperatures of nylon-11 and nylon-12 at about 190 °C and 179 °C, respectively).

Thus, Medoff's generic disclosure of "polyamides" without any specifically disclosed nylons combined with its disclosure of an extruder temperature of about 190 °C or less would simply suggest the use of nylons having melting temperatures at about 190 °C or less in their neat form. Additionally, the use of nylon-11 in each of Sato's examples indicates a strong preference for this polyamide, and the skilled artisan combining Medoff and Sato would simply use nylon-11 (i.e., a thermoplastic polymer that is consistent with Medoff's disclosed extrusion temperature and that *does not* have the recited melting temperature of 200 °C or above).

In response to these points, the advisory action (p. 4) cites Medoff's disclosure related to the compounding of its texturized fibrous material and resin in a 2-roll mill at 325 °F to 400 °F (i.e., 162 °C to 204 °C). Medoff, 5:33-35. However, this disclosure of Medoff relates to processing using a *2-roll mill*, not via *extrusion* as recited in the claims. Accordingly, there is no reason that the skilled artisan would ignore Medoff's explicit teaching with respect to an extrusion temperature and adopt the operating conditions from a different unit operation, in particular when the claims explicitly recite extrusion.

The advisory action also asserts that Medoff's disclosure of "about" 190 °C as an extrusion temperature "includes some values above 190 °C," apparently suggesting that "about 190 °C" extends above the recited temperature of 200 °C. Advisory action, p. 4. While the term "about" avoids a strict numerical interpretation, it should be interpreted in context, in particular with reference to the intrinsic evidence for the context in which it is used. *Pall Corp. v. Micron Separations, Inc.*, 66 F.3d 1211, 1217 (Fed. Cir. 1995). However, in this case, the advisory action provides no basis to interpret the disclosed value of "about 190 °C" as anything other than 190 °C, let alone as the recited temperature of 200 °C.

Additionally, Medoff's disclosure of a heat stabilizer is irrelevant to the recited process. As is commonly understood in the art, a heat stabilizer is an additive that protects a polymer composition (in particular those containing chlorine or bromine) from degradation of its polymer properties (e.g., discoloration, reduction of mechanical properties) resulting from *prolonged* thermal exposure. *Kirk-Othmer*, vol. 12, p. 225-226. Thus, heat stabilizers in general are unrelated to the melting temperature of the polymer composition and the high temperatures that may be experienced during polymer processing for short periods. Thus, Medoff's disclosure

of a heat stabilizer in no way provides a reason to incorporate the metal halide of Sato.

The assertion that Medoff's disclosure of "inorganic additives" somehow teaches or suggests the recited metal halides is unreasonable. Medoff provides specific examples of inorganic additives, none of which are related to the recited metal halides. See Medoff, 5:10-14 (disclosing calcium carbonate, graphite, asbestos, wollastonite, mica, glass, fiber glass, chalk, talc, silica, ceramic, ground construction waste, tire rubber powder, carbon fibers, and metal fibers as inorganic additives). The generic disclosure of "inorganic additives" is so broad and ill-defined in relation to the particularly recited metal halides that it cannot teach or suggest the metal halides without the benefit of impermissible hindsight. See *Ortho-McNeil*, slip op. at 10 (explaining that "simply retrac[ing] the path of the inventor with hindsight, discount[ing] the number and complexity of alternatives ... is *always inappropriate* for an obviousness test" (emphasis added)).

Further, even if a different polyamide were selected from Sato (e.g., nylon-6 having a melting temperature of about 223 °C), the skilled artisan still would not have been prompted to combine the elements of Sato and Medoff in the manner claimed. While Sato discloses that its metal halide additive affects the melting point of its polyamide, Sato emphasizes that the important contribution of the metal halide additive is to the balance of desirable physical and mechanical properties of the resulting composite. See Section II.B above. Thus, the skilled artisan optimizing this hypothetical combination would be concerned with physical/mechanical properties of the final material (i.e., and *not* the melting temperature of the material during processing), and the skilled artisan would *not* arrive at the recited process.

Accordingly, the action fails to provide a reason prompting the skilled artisan to combine the references in the manner claimed. *KSR*, 127 S.Ct. at 1739; MPEP § 2143(A).

3. Conclusion

For the foregoing reasons, the applicants submit that each of the reasons provided above is independently sufficient to preclude a conclusion that the pending claims are *prima facie* obvious over Medoff in view of Polovina and Sato. Accordingly, the applicants request reconsideration and withdrawal of the obviousness rejection.

D. Objective Evidence of Non-Obviousness

Notwithstanding the foregoing discussion regarding the lack of a *prima facie* case of obviousness, the applicants further submit that the pending claims are allowable on the basis of objective evidence of non-obviousness in the form of comparative data present in the application specification.

1. Comparative Mechanical Data

The application specification presents tensile and flexural properties for composites prepared according to the recited processes. The application examples were performed using a nylon-6 thermoplastic polymer, a variable amount of lithium chloride metal salt, and a variable amount of hemp natural fiber. Application specification, ¶ 86 (Table 4). The tensile and flexural properties of the resulting composites (and a neat nylon-6 reference) are summarized in Table 1 below.² Table 1 also includes comparative data from the examples of Medoff³ and Sato⁴.

Table 1. Comparative Mechanical Properties

	Spec. 1	Spec. 7	Spec. 8	Spec. 3	Spec. 4	Medoff	Sato
Polymer	Nylon-6	Nylon-6	Nylon-6	Nylon-6	Nylon-6	HDPE	Nylon-11
Metal Salt (wt.%)	—	3.0	3.0	3.5	3.5	—	1.0-4.8
Natural Fiber (wt.%)	—	30	40	15	30	40-59	—
Tensile Str. (MPa)	62.7	70.0	76.0	67.6	71.6	n/a	14.7-35.3
Tensile Mod. (GPa)	2.3	5.4	6.7	3.5	5.1	n/a	n/a
Flexural Str. (MPa)	84.5	120.7	120.8	123.3	128.4	53.8-78.6	n/a
Flexural Mod. (GPa)	2.2	5.8	7.8	4.5	6.5	4.3-5.0	n/a

² In Table 1, the application specification data entries are labeled "Spec. 'n'", where "n" represents the nth row entry of specification Table 4.

³ Compositions 1, 2, 3, and 7 of Example 2 are presented for comparison because they are the most similar to application examples. Specifically, the present examples of Medoff include a polymer matrix and a natural fiber reinforcement, but do not include a calcium carbonate inorganic filler (i.e., similar to the application examples).

⁴ Experiments 4-6, 12, 24-27, 31-35, and 41-43 of Examples 1-6 are presented for comparison because they contain all four of the essential components of Sato's disclosure.

From Table 1 above, it is apparent that composites prepared according to the recited processes have substantially improved mechanical properties compared to relevant prior art compositions. The substantial improvement over neat nylon-6 ("Spec. 1" in Table 1) is relevant because, it illustrates the ability to reinforce a high-melting thermoplastic polymer with a temperature sensitive natural fiber without degrading the fiber. The comparisons with the applied references of Medoff and Sato further illustrate substantial improvements in composite strength based on the ability of the recited method to process stronger base thermoplastic polymers without degrading the natural fiber reinforcement.

2. Response to Advisory Action

The advisory action discounts the foregoing objective evidence of non-obviousness, because "cellulosic material (sometimes known as lignocellulose) are well known and conventional reinforcing materials for thermoplastics." Advisory action, p. 5. Thus, the action effectively asserts that unexpected results with respect to the strength of a cellulosic-reinforced thermoplastic composite material cannot be demonstrated, because some degree of strength improvement would be expected in any event.

The applicants respectfully disagree with this reasoning, inasmuch as it over-generalizes the specific issue of unexpected results relevant to the present claims. The issue is *not* simply whether the recited temperature-sensitive natural filler would have been expected to improve the strength of the recited high-melting temperature thermoplastic polymer. Rather, the issue is whether the skilled artisan would have expected that the temperature-sensitive natural filler could have been successfully used as a reinforcement in an article with a composite matrix based on a thermoplastic polymer whose melting temperature is high enough to thermally degrade the natural filler (e.g., in a melt-forming process at a temperature of 200°C or above).

As explained in the application specification, previous attempts at using a temperature-sensitive natural filler as a reinforcement have been limited to using low-melting thermoplastic matrix polymers:

Researchers have successfully used natural fibers as reinforcing materials replacing the glass fibers. But they have been forced to adhere to low temperature melting thermoplastic-natural fiber composites as the natural fibers start to degrade thermally at or

above 200°C. Thermal degradation of natural fibers results in poor physico-mechanical properties and discoloration of the fibers. Reinforcing high temperature melting thermoplastics which melt above 200°C with natural fibers has turned out to be a challenging task.

Application specification, ¶ 8. Further, approaches that incorporate a natural filler into a high-melting temperature thermoplastic polymer during extrusion still suffer when the composite extrudate is injection-molded to form an article at a temperature sufficiently high to thermally degrade the natural filler. *Id.*, ¶ 9.

Thus, the comparison presented in Table 1 between column 1 and columns 2-5 (i.e., neat nylon-6 vs. natural filler-reinforced nylon-6 according to the claims) is relevant to the issue of unexpected results. Because nylon-6 has a melting temperature of about 223°C, the skilled artisan would not have expected that a composite matrix of nylon-6 reinforced with a natural filler would have substantially improved mechanical properties, at least in part due to the expected thermal degradation of the filler. Contrary to this expectation, however, Table 1 illustrates a substantial improvement in each of the tensile strength, tensile modulus, flexural strength, and flexural modulus, with increases of 8%-21%, 52%-191%, 43%-52%, and 105%-254%, respectively.

Notwithstanding the expectations of the skilled artisan, Table 1 also illustrates substantial increases in mechanical properties over the closest cited prior art references (i.e., Medoff and Sato). See MPEP § 716.02(e)(III) (claimed method may be compared with the closest subject matter that exists in the prior art). For example, Medoff reports the flexural strength and flexural modulus of its compositions, and the compositions according to the claimed methods demonstrate an improvement in these two properties of about 57%-129% and 23%-43%, respectively.⁵ Further, while Medoff does not report any tensile strength values in its examples, the fact that neat HDPE has a tensile strength of about 20 MPa to about 30 MPa⁶, indicates that the tensile strength of compositions according to the claims are significantly higher, even taking into consideration a strength increase based on the inclusion of a reinforcement. Similarly, the compositions according to the claims are also stronger

⁵ Based on an average flexural strength of 123.3 MPa and an average flexural modulus of 6.15 GPa for the entries of columns 2-5.

⁶ *Kirk-Othmer*, vol. 16, p. 427 (listing tensile strengths of HDPE as a function of density).

than those of Sato, having an increase in tensile strength of about 102%-385% relative to Sato.⁷

Accordingly, the recited methods provide the unexpected and substantial benefits of being able to combine a high-melting temperature thermoplastic polymer that has favorable base mechanical properties with an inexpensive, temperature-sensitive natural filler reinforcement while still being able to obtain the strength improvements of a filler-reinforced composite. Thus, the resulting composite can be produced at a reduced cost in combination with improvements in strength, recyclability, etc. Application specification, ¶ 6.


The applicants submit that the foregoing represents a sufficient demonstration of unexpected results for the pending claims. Accordingly, the applicants request reconsideration and withdrawal of the obviousness rejection on this additional basis.

⁷ Based on an average tensile strength of 71.3 MPa for the entries of columns 2-5.

CONCLUSION

In view of the foregoing, entry of amendments to claims 1, 10, 18, and 22, cancellation of claim 6, reconsideration and withdrawal of the rejection, and allowance of all claims 1, 2, 4, 5, 7, 9-15, and 17-22 are respectfully requested.

Respectfully,

A handwritten signature in black ink, appearing to read 'Ian C. McLeod', written over a horizontal line.

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